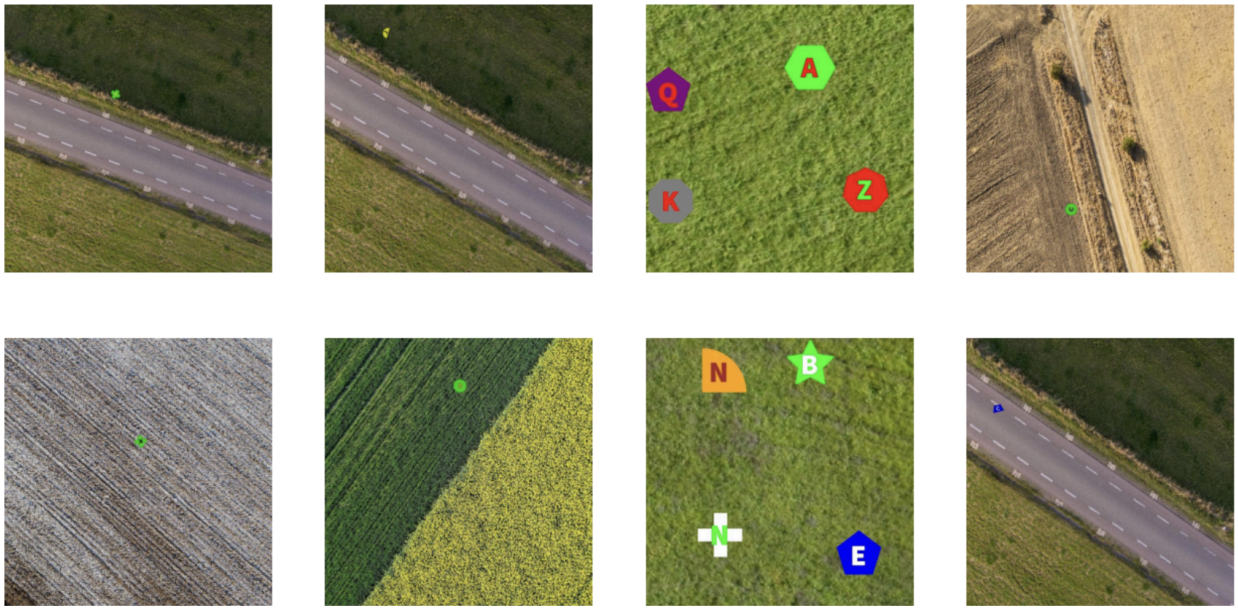
Task 2 Report

Kaggle Notebook:
https://www.kaggle.com/code/mo7amedbassem/alexeagles-megaproject-task2

Dataset Samples



All images and their corresponding labels were sourced from Roboflow. The original dataset consisted of 7,200 entries, which were increased to 12,798 through data augmentation. It is also worth mentioning that we have experimented with synthetic data, and managed to produce this dataset. However, the final decision was made to use the dataset we found on Roboflow.

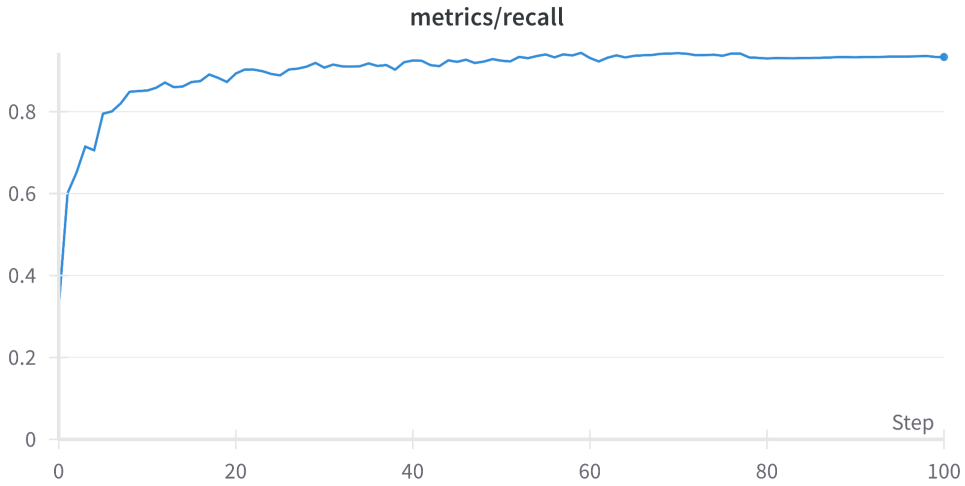
Models Used

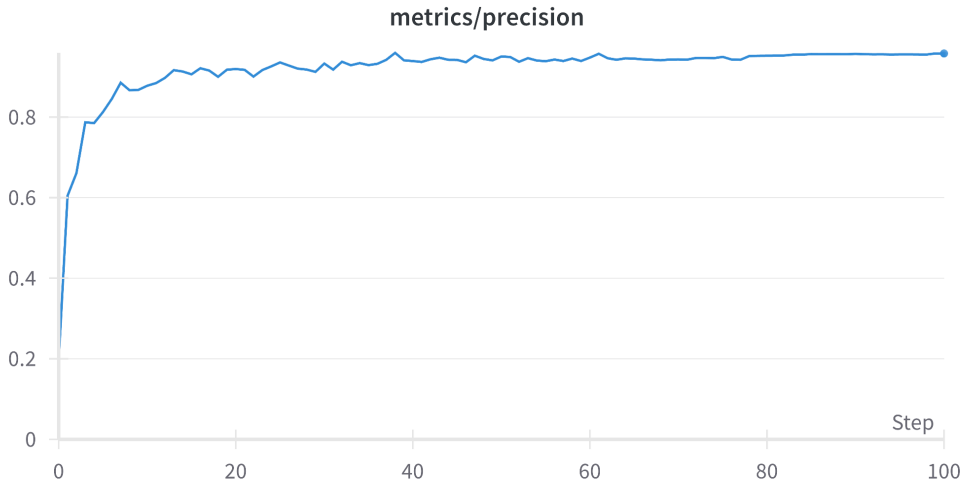
Model	Model Size	Inference Time	Accuracy (mAP@0.5)	Strengths	Weaknesses
YOLOv5	27 MB – 250 MB	5–12 ms	50–60%	Fast, real-time, scalable	Slightly less accurate for small objects
Faster R-CNN	~500 MB	~200 ms	60–70%	High accuracy, good for small objects	Slow, not real-time
EfficientDet	20 MB – 300 MB	25–70 ms	50–70%	Scalable, efficient, flexible	Complex to implement
SSD	~100 MB	~20 ms	40–50%	Balanced speed and accuracy, mobile-friendly	Lower accuracy than YOLO and R-CNN
RetinaNet	~150–200 MB	~150 ms	60–65%	Focal loss helps with class imbalance	Higher computational needs

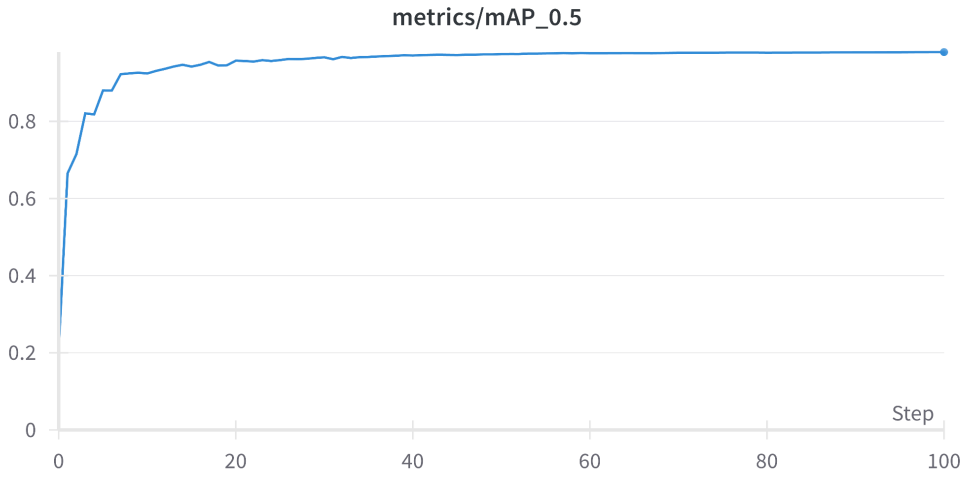
For the shape detection and classification task, we decided to use YOLOv5 due to its faster inference time compared to the other models. Its performance in terms of speed made it a suitable choice for our application, where real-time or near real-time processing is essential.

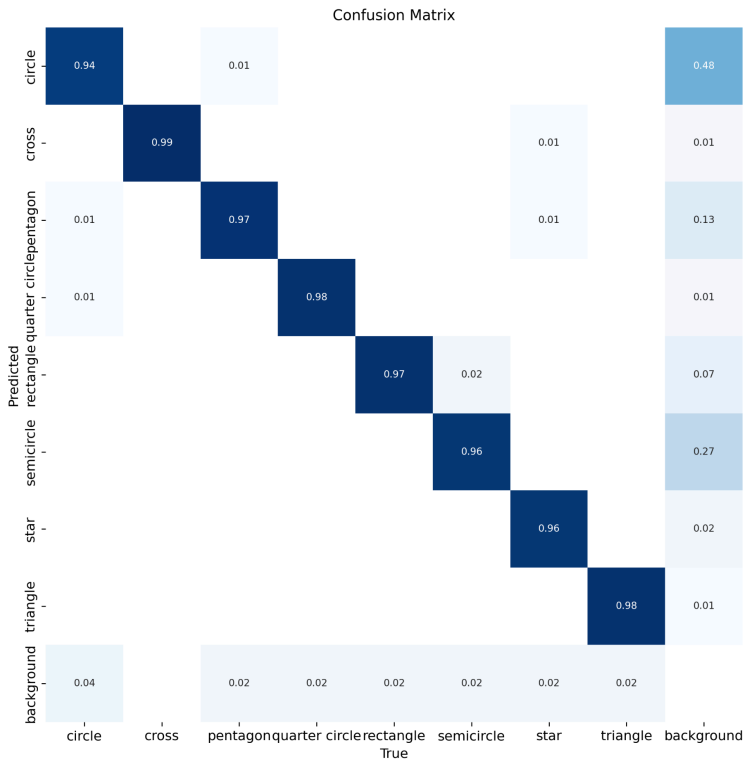
For the color classification task, we selected the Random Forest model, as it showed better accuracy compared to the K-Nearest Neighbors algorithm during our analysis. Detailed performance charts for each algorithm are available in the Kaggle notebook.

Metrics


metrics/recall
0.8
0.6
0.4
0.2
0
Step
0
20
40
60
80
100

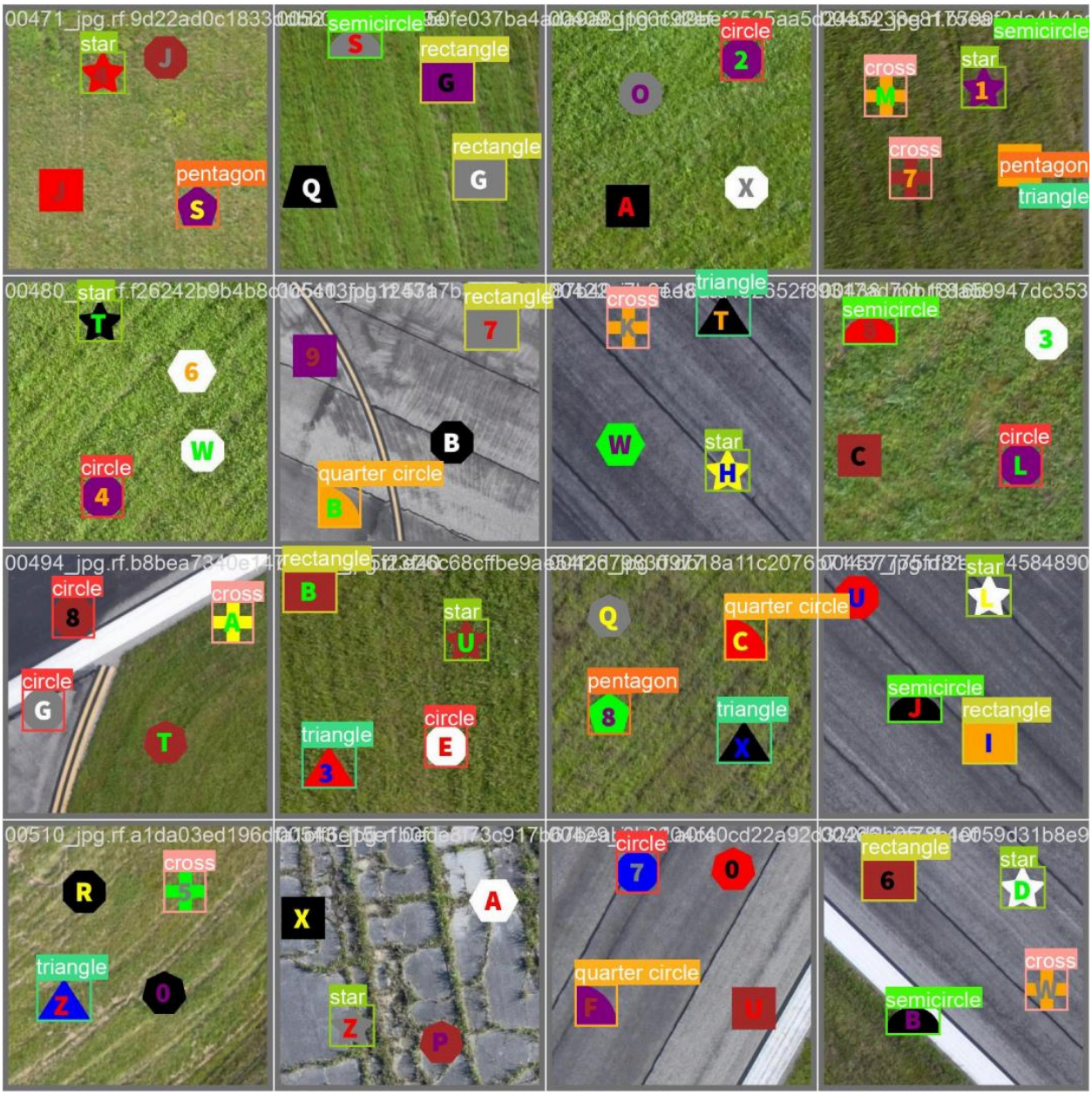

metrics/precision
0.8
0.6
0.4
0.2
0
Step
0
20
40
60
80
100


metrics/mAP_0.5
0.8
0.6
0.4
0.2
0
Step
0
20
40
60
80
100



A script used to calculate the model's accuracy can also be found in the Kaggle notebook, indicating that we achieved an accuracy of 96.04% on the test data.

Sample Results



Object: cross, Color: Yellow

Object: quarter circle, Color: Blue


```
Bounding box coordinates for cross: xmin = 86, ymin = 445, xmax = 192, ymax = 549
Object: cross, Coordinates in meters: x = -33.80617854326034, y = -38.536336562812636
Coordinates in lat/lon: lat = 38.31695084215288, lon = -76.55656377176008

Bounding box coordinates for cross: xmin = 359, ymin = 423, xmax = 465, ymax = 527
Object: cross, Coordinates in meters: x = 16.48531207989031, y = -33.1754311219985
Coordinates in lat/lon: lat = 38.31699000000589, lon = -76.55598795919738

Bounding box coordinates for semicircle: xmin = 129, ymin = 110, xmax = 265, ymax = 178
Object: semicircle, Coordinates in meters: x = -22.28702281863705, y = 38.28666708922791
Coordinates in lat/lon: lat = 38.317640955224014, lon = -76.55643188315436

Bounding box coordinates for star: xmin = 463, ymin = 179, xmax = 575, ymax = 284
Object: star, Coordinates in meters: x = 37.62116252948551, y = 18.263904684068002
Coordinates in lat/lon: lat = 38.31746108761407, lon = -76.55574596421847
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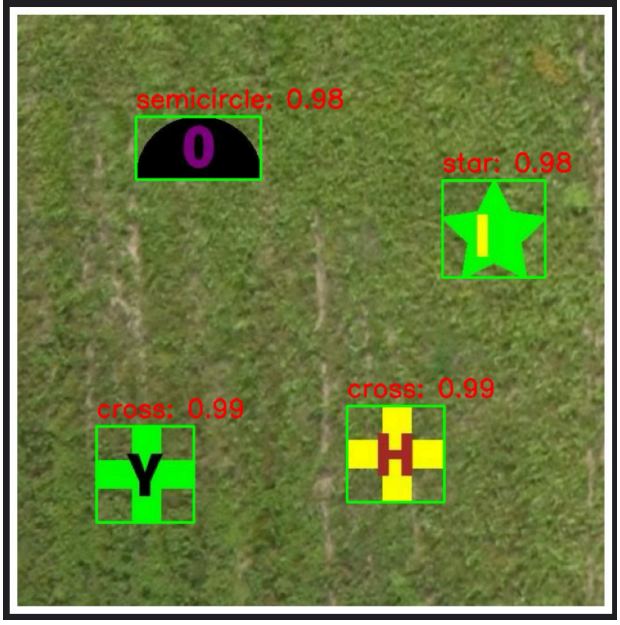


```
Bounding box coordinates for rectangle: xmin = 518, ymin = 124, xmax = 529, ymax = 144
Object: rectangle, Coordinates in meters: x = 38.59683202124269, y = 40.81151335031557
Coordinates in lat/lon: lat = 38.317663636313334, lon = -76.5557347932879

Bounding box coordinates for star: xmin = 469, ymin = 440, xmax = 487, ymax = 457
Object: star, Coordinates in meters: x = 29.11267748793811, y = -27.035959691099613
Coordinates in lat/lon: lat = 38.31705415183911, lon = -76.55584338214179

Bounding box coordinates for rectangle: xmin = 64, ymin = 563, xmax = 83, ymax = 572
Object: rectangle, Coordinates in meters: x = -48.44524950150018, y = -58.0484367997536
Coordinates in lat/lon: lat = 38.31677556190115, lon = -76.556731381844

Bounding box coordinates for circle: xmin = 337, ymin = 505, xmax = 356, ymax = 523
Object: circle, Coordinates in meters: x = 4.688292656491125, y = -42.87877170886362
Coordinates in lat/lon: lat = 38.316911833378, lon = -76.5561230292043

Bounding box coordinates for star: xmin = 508, ymin = 517, xmax = 526, ymax = 535
Object: star, Coordinates in meters: x = 37.19046494339399, y = -46.06592917150294
Coordinates in lat/lon: lat = 38.31688320264345, lon = -76.5557508954917

Bounding box coordinates for rectangle: xmin = 446, ymin = 203, xmax = 454, ymax = 220
Object: rectangle, Coordinates in meters: x = 23.62590425378992, y = 22.587064977164104
Coordinates in lat/lon: lat = 38.3174999232399 2, lon = -76.5559062029673

Bounding box coordinates for cross: xmin = 621, ymin = 190, xmax = 638, ymax = 208
Object: cross, Coordinates in meters: x = 65.17922801305512, y = 25.351084190798005
Coordinates in lat/lon: lat = 38.317524752857324, lon = -76.55543043807057
```